

### **REMARKS**

Claims 1-6, 12-18, 23 and 33-36 were pending under this Office Action. Claims 6 and 18 have been allowed. Claim 23 was objected to. Claims 1-5, 12-17 and 33-36 have been rejected. Claims 23 and 33 are hereby amended and claim 34 has been cancelled.

Favorable reconsideration of this application is respectfully requested in view of the amendments and following remarks. Each of pending claims 1-6, 12-18, 23, 33, 35 and 36 is believed to be in condition for allowance.

#### **I. Allowable Subject Matter**

Applicants thank the Examiner for indicating, in paragraph 5, that claims 6 and 18 have been allowed.

Claim 23 was objected to in paragraph 6 of the subject Office Action. It was indicated that claim 23 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 23 has been amended and now independent claim 23 recites all of the features of base claim 1, from which claim 23 had depended. Claim 23 is therefore in allowable form.

#### **II. Claim Rejections - 35 U.S.C. § 102(b)**

In the Office Action, specifically in paragraph 2, claims 33-35 were rejected under 35 U.S.C. § 102(b) as being anticipated by Chang et al. (U.S. Patent No. 6,143,579), hereinafter "Chang". Applicants respectfully submit that these claim rejections are obviated for reasons set forth below.

Claim 34 has been cancelled and its features added to independent claim 33. Amended claim 33 recites the feature of "measuring a voltage required to induce a FN tunneling based current". The cited reference of Chang does not teach or suggest

measuring a voltage required to induce a FN tunneling based current. Rather, Chang teaches measuring  $Q_{BD}$  (charge-to-breakdown) and  $E_{BD}$  (breakdown field). These measurements are distinguished from a voltage measurement, and more particularly distinguished from measuring a voltage required to induce a FN tunneling based current. Not only are different measurements recited - charge and electric field compared to a voltage, but the object of the measurements and the information obtained is also distinguished: Chang is limited to measuring damage that occurs to a thermally formed gate oxide during a plasma processing operation whereas the claimed invention measures a voltage required to induce a current in a deposited interlevel oxide, not a gate oxide.

Therefore, independent amended claim 33 is distinguished from Chang and since claim 35 depends directly from claim 33, the rejection of claims 33 and 35 as being anticipated by Chang, should be withdrawn.

Applicants respectfully point out that claim 33 is **not** a method of making claim; rather, it is a claim directed to a method for monitoring electric charge effect occurring during semiconductor processing, as clearly recited in the preamble. Therefore, the step of measuring plasma damage is not an intended use recitation in a method of making claim, but rather is essential to the stated method of monitoring, and bears patentable weight.

### III. Claim Rejections - 35 U.S.C. § 103(a)

In the Office Action, specifically in paragraph 4, claims 1-5, 12-17 and 36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of Yang (U.S. Patent No. 5,913,102) and Ahn (U.S. Patent No. 5,563,080). Applicants respectfully submit that these claim rejections are overcome based on the remarks set forth below.

Claims 1, 13 and 36 are the independent claims of the claims rejected under this paragraph. Each of independent claims 1, 13 and 36 recite the feature of

"measuring a voltage required to induce a FN tunneling based current".

For reasons stated above, each of independent claims 1, 13 and 36 are distinguished from Chang. Applicants again point out that the claimed invention is directed to a process of monitoring, not a method of making, and as such, the different claimed measurement method features carry patentable weight. The reference of Yang has apparently been relied upon for providing a substrate with a layer of N-type conductivity having been created in the surface of the substrate. The reference of Ahn has apparently been relied upon for providing a patterning and etching technique. Applicants respectfully submit that neither Yang nor Ahn make up for the above-stated deficiencies of Chang. The above-indicated feature therefore establishes that independent claims 1, 13 and 36 are distinguished from the references of Chang, Yang and Ahn, taken alone or in combination.

Each of Independent claims 1 and 13 also recite:

"etching said exposed regions of said substrate using said pattern of LOCOS regions as a hard mask, creating a pattern of elevated LOCOS regions, creating trenches having inside surfaces in said substrate"; and

creating a layer of interlayer oxide over said pattern of LOCOS regions and said inside surfaces of said trenches created in said substrate.

Independent claim 36 recites the feature of:

"providing a monitor substrate . . . including oxidized regions formed thereover and interspersed with trench regions that each include an opening extending into said monitor substrate, an interlayer oxide layer disposed over said oxidized regions and said trench regions".

As acknowledged by the Examiner, for example on page 4, line 5-7 of the subject Office action, "Chang does not disclose etching the exposed regions of the substrate using the pattern of LOCOS regions as a hard mask, creating a pattern of elevated

LOCOS regions, creating trenches having inside surfaces in the substrate". Applicants further point out that, since Chang does not teach creating trenches (having inside surfaces) in the substrate, Chang cannot and does not teach the claimed feature of creating a layer of interlayer oxide over the LOCOS regions and over the inside surfaces of the trenches created in the substrate (claims 1 and 13) or over the trench regions that extend into the substrate (claim 36). Therefore, each of independent claims 1, 13 and 36 recite additional features that further distinguish Applicants' invention from Chang. The oxide layer referred to by the Examiner, gate oxide 14 in Chang, is not formed on inside surfaces of the substrate because there are no trenches or inside surfaces of the substrate in Chang. Moreover, gate oxide layer 14 of Chang is not formed over the FOX 12 of Chang (comparable to LOCOS) as in the claimed invention, because a gate oxide is thermally grown and while the FOX 12 of Chang may be further oxidized under extreme thermal oxidation conditions, any further oxidation will take place at the FOX/substrate interface and thus a film will not be formed "over" FOX 12. At any rate, gate oxide layer 14 of Chang is clearly not formed over FOX 12 as is the claimed oxide layer of claims 1, 13 and 36, such as illustrated in Figure 10 of the subject application which shows deposited oxide layer 36 formed over field oxide regions 34.

The Examiner then states that it would have been obvious to use the etching with LOCOS regions as hard masks of Ahn in the method of Chang and Yang in order to improve integration of a semiconductor device by preventing junction breakdown from occurring as stated by Ahn in column 4, lines 11-14. Applicants respectfully submit that one of ordinary skill in the art and in possession of the Chang invention - directed to forming a test structure to monitor gate oxide damage, WOULD NOT be inclined to use the teaching of Ahn because Ahn teaches forming improved high voltage transistors. There would be **NO** motivation for one of ordinary skill in the art, to modify the test structure of Chang to form a high voltage transistor resistant to junction breakdown simply because **Chang does not form high voltage transistors - Chang forms a test structure**. In particular, Ahn is directed to providing an improved high voltage transistor

using a novel second gate electrode formed under a bird's beak of field oxide but Chang merely provides a test structure that is used in a particular process to monitor a plasma etching chamber. If the test structure of Chang was varied, it would cease to be replicative of the structure and the process which it is designed to monitor.

In particular, Ahn teaches forming gate electrodes at a level below the level of the field oxide film and simultaneously forming further gate electrodes in the form of spacers below a bird's beak of the field oxide film. Chang is directed to assessing the plasma damage that occurs due to the etching chamber when a conformal oxide is formed over a polysilicon plate and the wafer is subjected to a spacer etch that produces oxide spacers along the polysilicon structure. Applicants submit that forming the polysilicon structure of Chang beneath the level of the field oxide/LOCOS, would defeat the purpose of Chang because the product Chang is trying to replicate with his test structure doesn't include this feature and doing so would produce a locally thicker overlying oxide 22 that would require the spacer etching process to be changed and therefore would not represent the plasma damage seen by the polysilicon 20 and gate oxide 14 of the product wafers that the Chang test structure is modeled after. As such, it would be detrimental, not obvious, for one practicing the Chang method, to combine its teachings with those of Ahn.

Moreover, neither of the cited references of Yang or Ahn teach or suggest the feature of measuring a voltage required to induce a FN tunneling based current and neither Chang nor Yang nor Ahn perform any measurement associated with the integrity of an interlevel oxide layer as does the claimed invention.

Since it would not be obvious to combine the teachings of Ahn with those of Chang, and since independent claims 1, 13 and 36 each recite features neither disclosed nor suggested by the references of Chang, Yang and Ahn, taken alone or in combination, the rejection of claims 1, 13 and 36 under 35 U.S.C. § 103(a), should be withdrawn. Claims 2-5 and 12 depend from claim 1 and claims 14-17 depend from independent claim 13. Since each of these claims incorporate the distinguishing

features of their base claims, the rejection of claims 2-5, 12 and 14-17 under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of Yang and Ahn, should also be withdrawn. Each of claims 1-5, 12-17 and 36 is distinguished from the cited references, taken alone or in combination.

**CONCLUSION**

Based on the foregoing, each of claims 1-6, 12-18, 23, 33, and 35-36 is in allowable form and the application is therefore in condition for allowance, which action is respectfully and expeditiously requested by applicants.

Respectfully submitted,

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